Strategies to combine novel traits across countries: example of heat stress

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[6] Association Wallonne de l'Elevage – Ciney, Belgium

Novel traits

- INTERBULL:
  - Evaluations for many countries
  - But only for traditional traits
- Novel traits
  - Growing interest
  - Not yet addressed by INTERBULL
- However international collaboration of highest interest but “the king phenotypes” still holds in opposing☺

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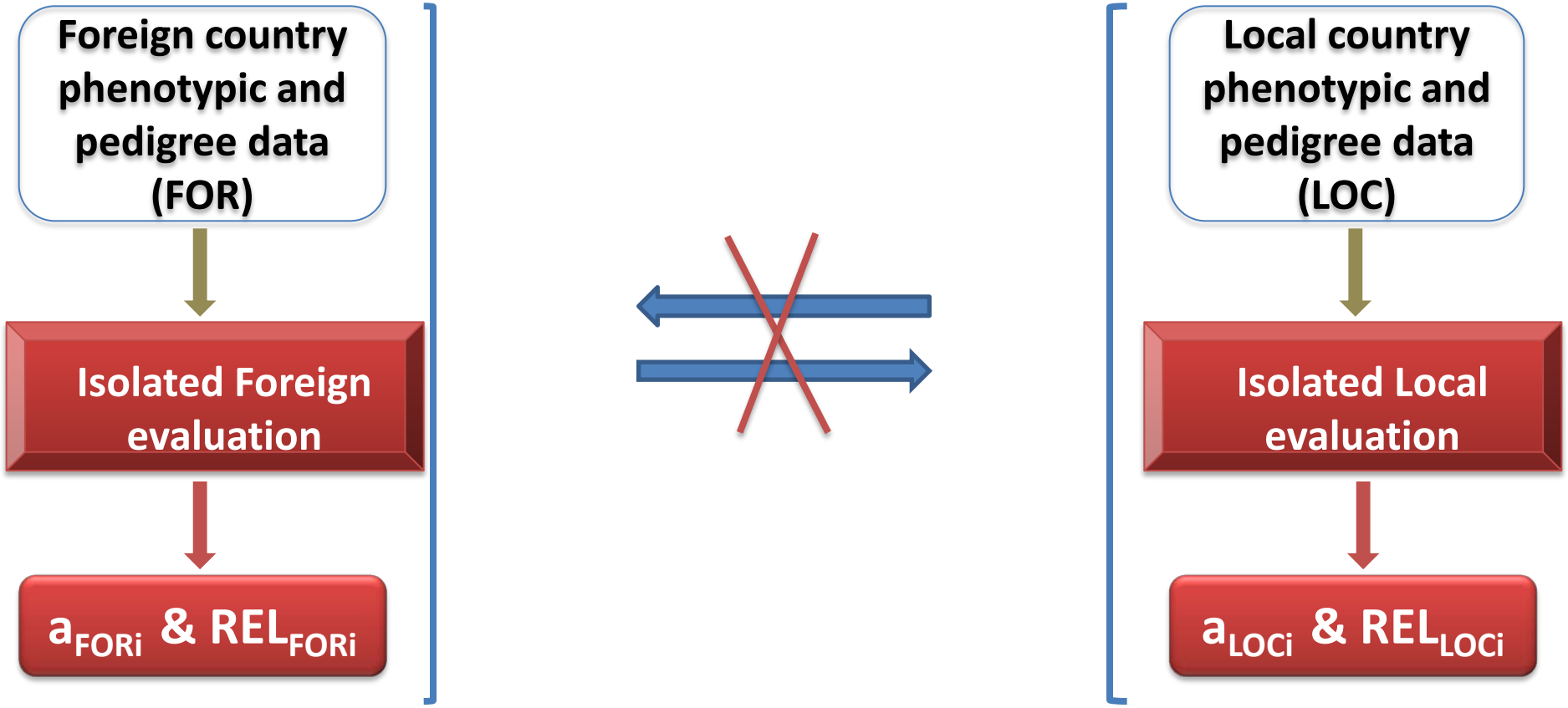
➔ proposal for a strategy applicable to genetic evaluation for novel traits (here heat tolerance)

Novel traits: current situation



Novel traits: free access to raw data

Foreign country phenotypic and pedigree data (FOR)

Local country phenotypic and pedigree data (LOC)

Joint evaluation

a_{FORj} & REL_{FORj}

a_{LOCj} & REL_{LOCj}

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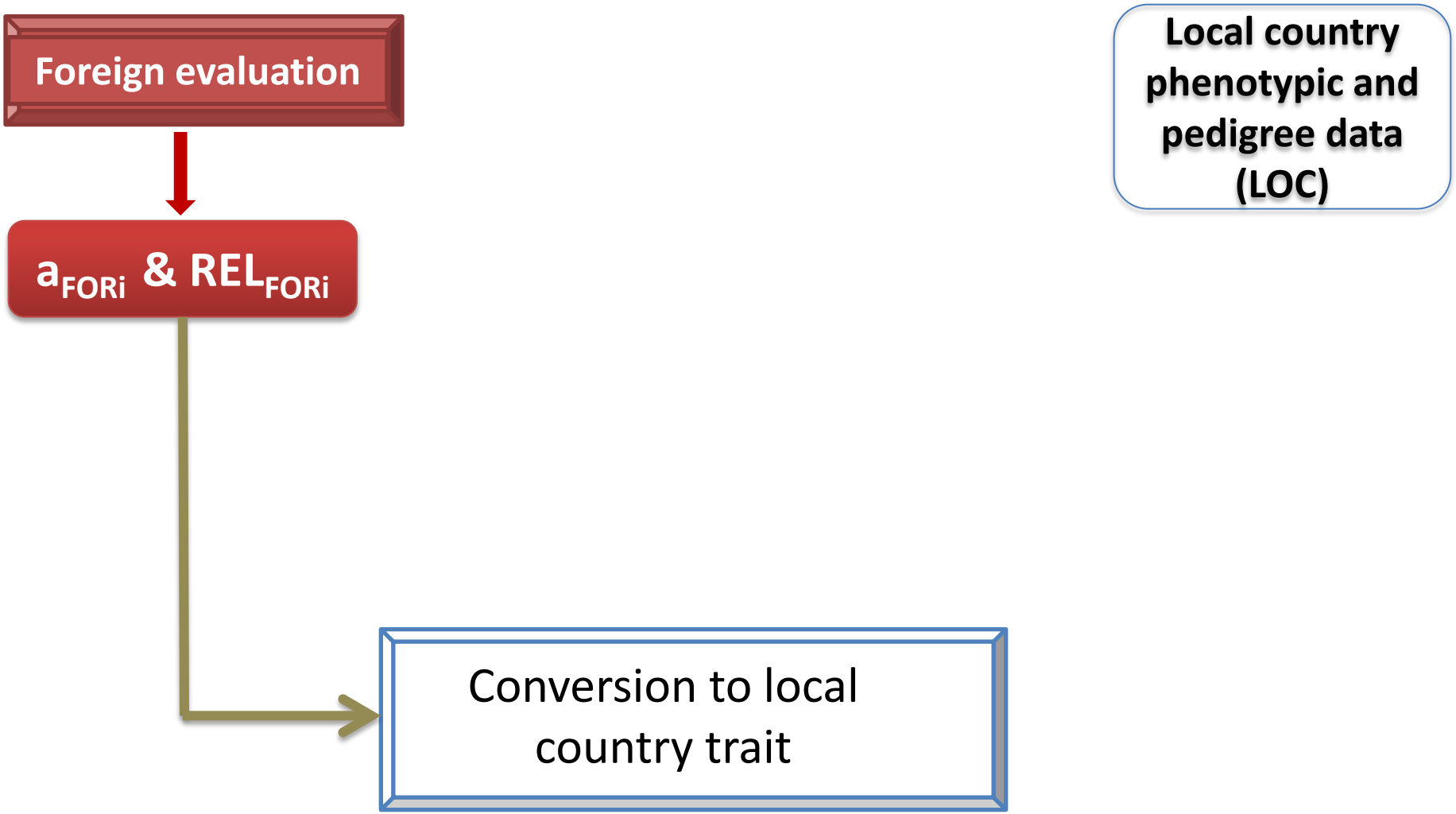

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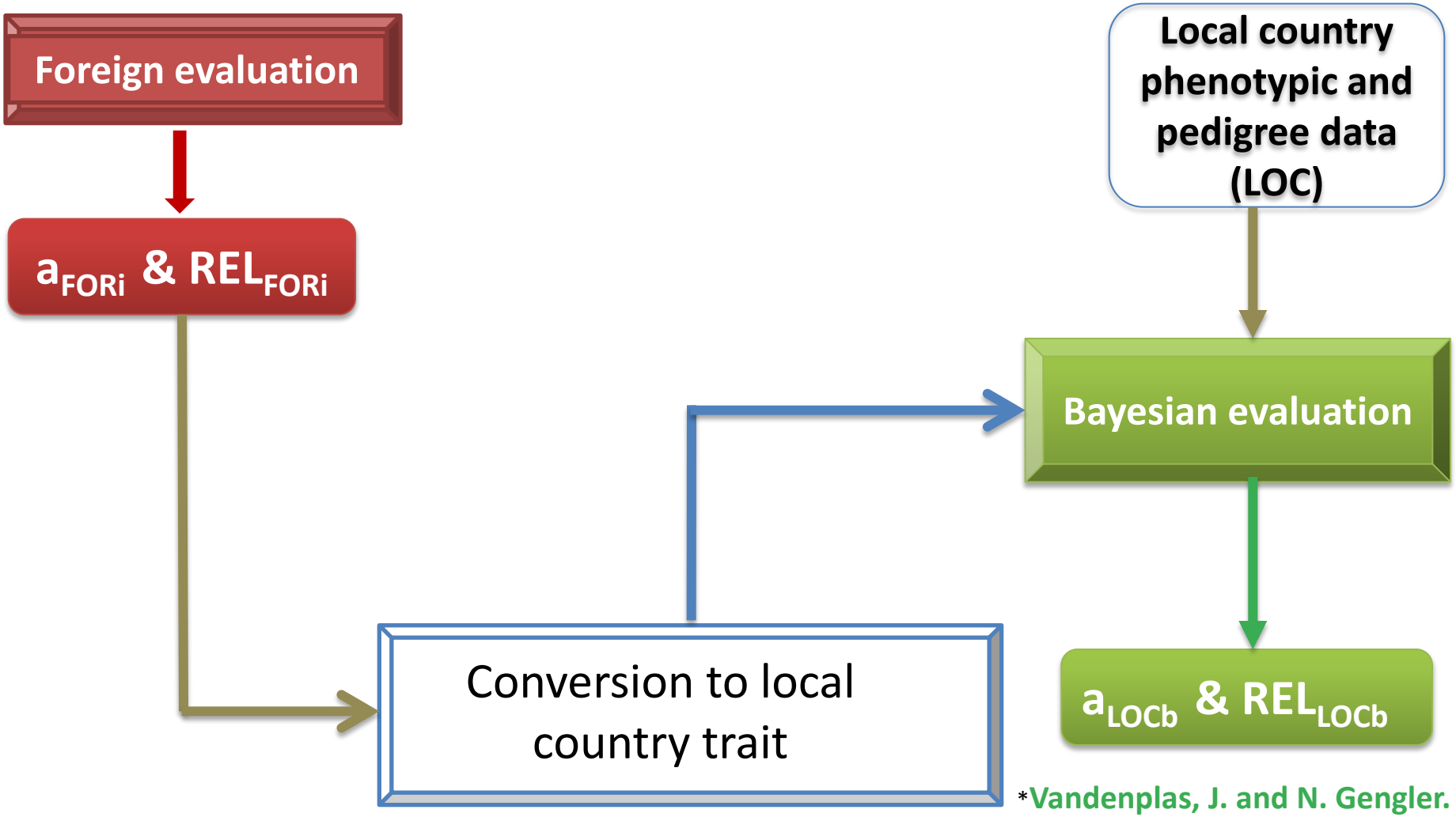


*Vandenplas, J. and N. Gengler. 2012. J. Dairy Sci. 95:1513-1526

Objective

Ascertain rankings of individuals in the local country depending on information accessed from foreign country

- **Scenario A: free access to raw data**

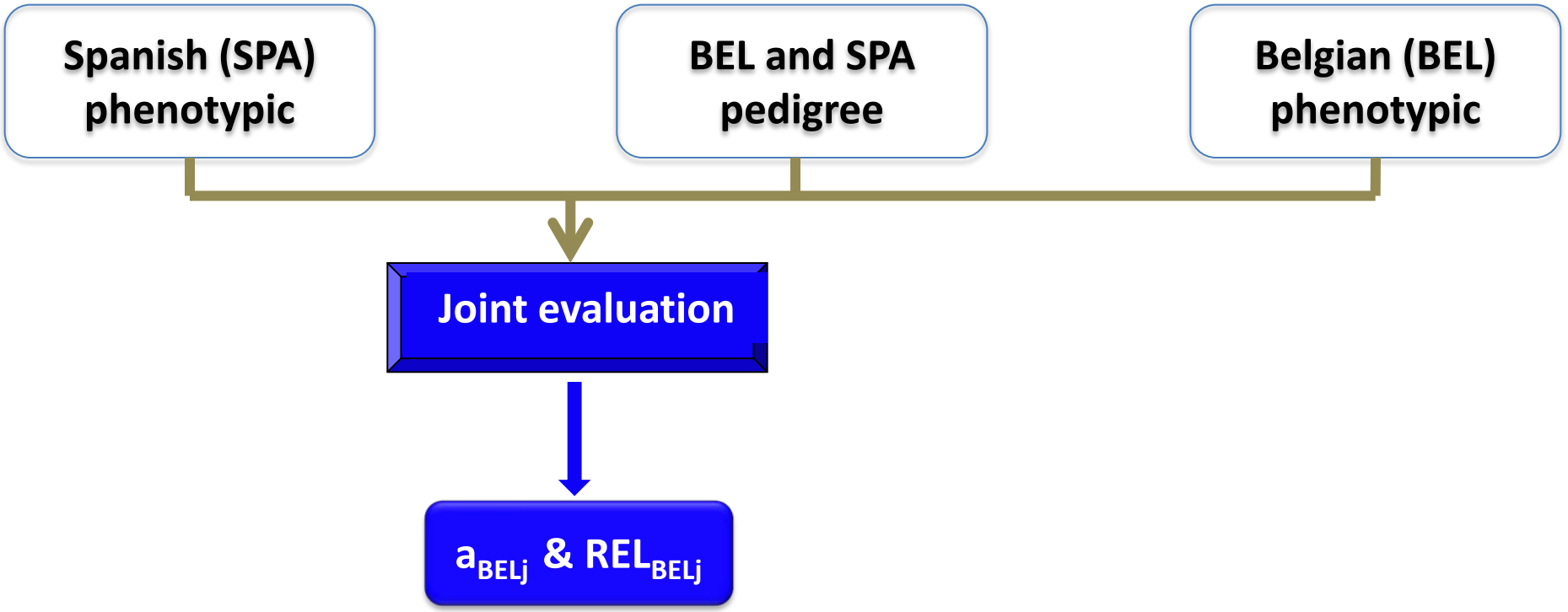
Local evaluation *vs* Joint evaluation

- **Scenario B: free access to EBV and REL**

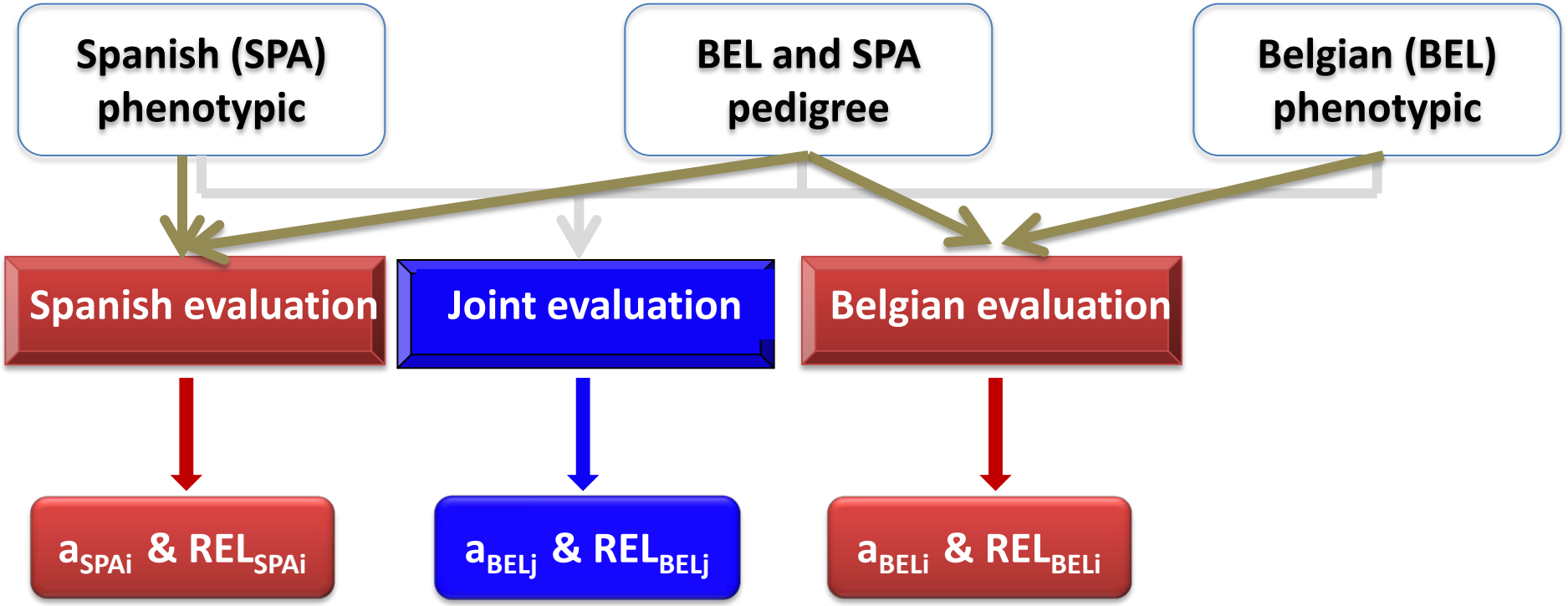
Bayesian evaluation *vs* Joint evaluation

➔ **- Local (Belgium, temperate) and Foreign (Spain, mediterranean)**
- Novel trait: Heat tolerance

Methods


Spanish (SPA) phenotypic
BEL and SPA pedigree
Belgian (BEL) phenotypic
Joint evaluation
a_{BELj} & REL_{BELj}

Methods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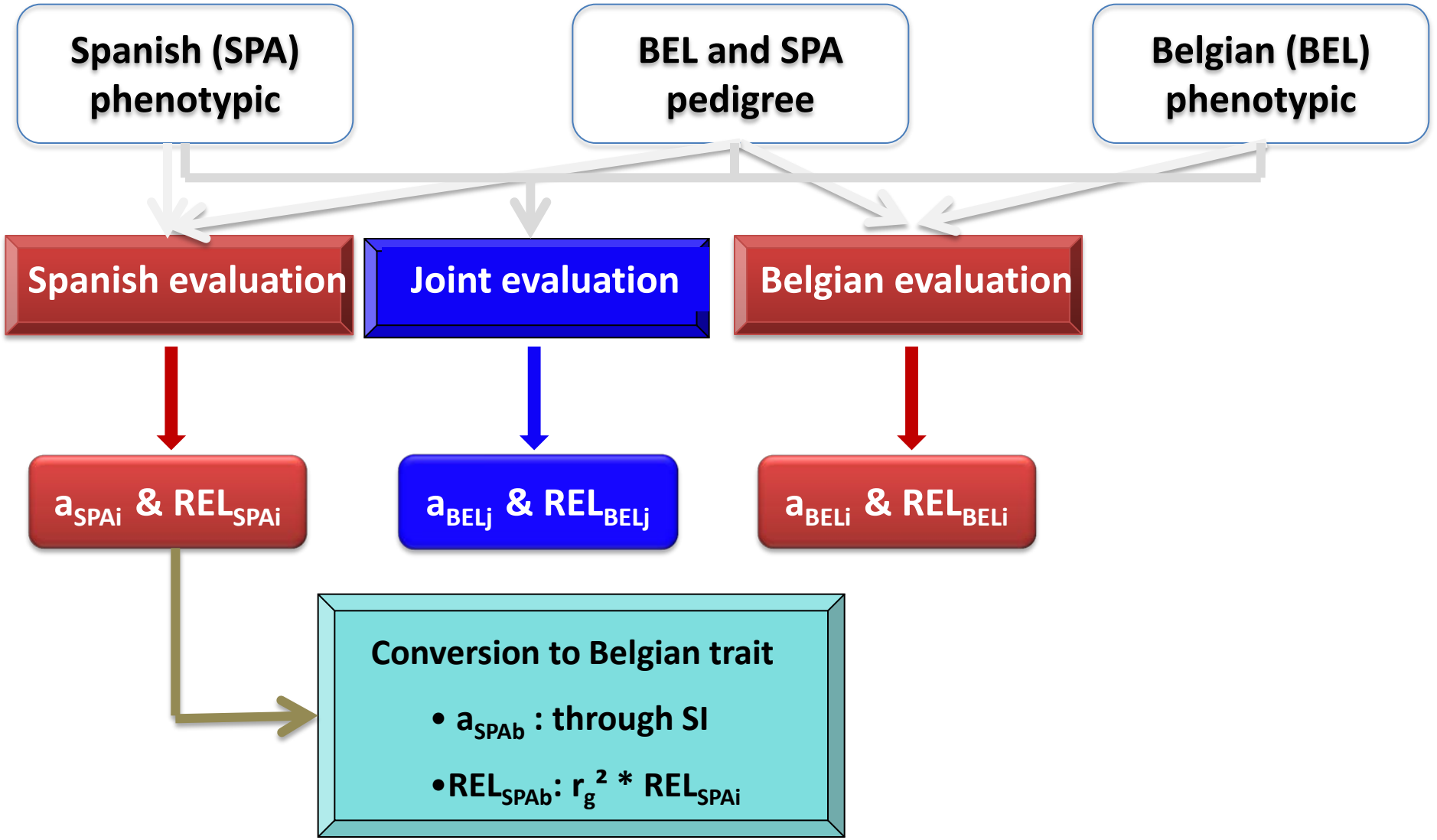
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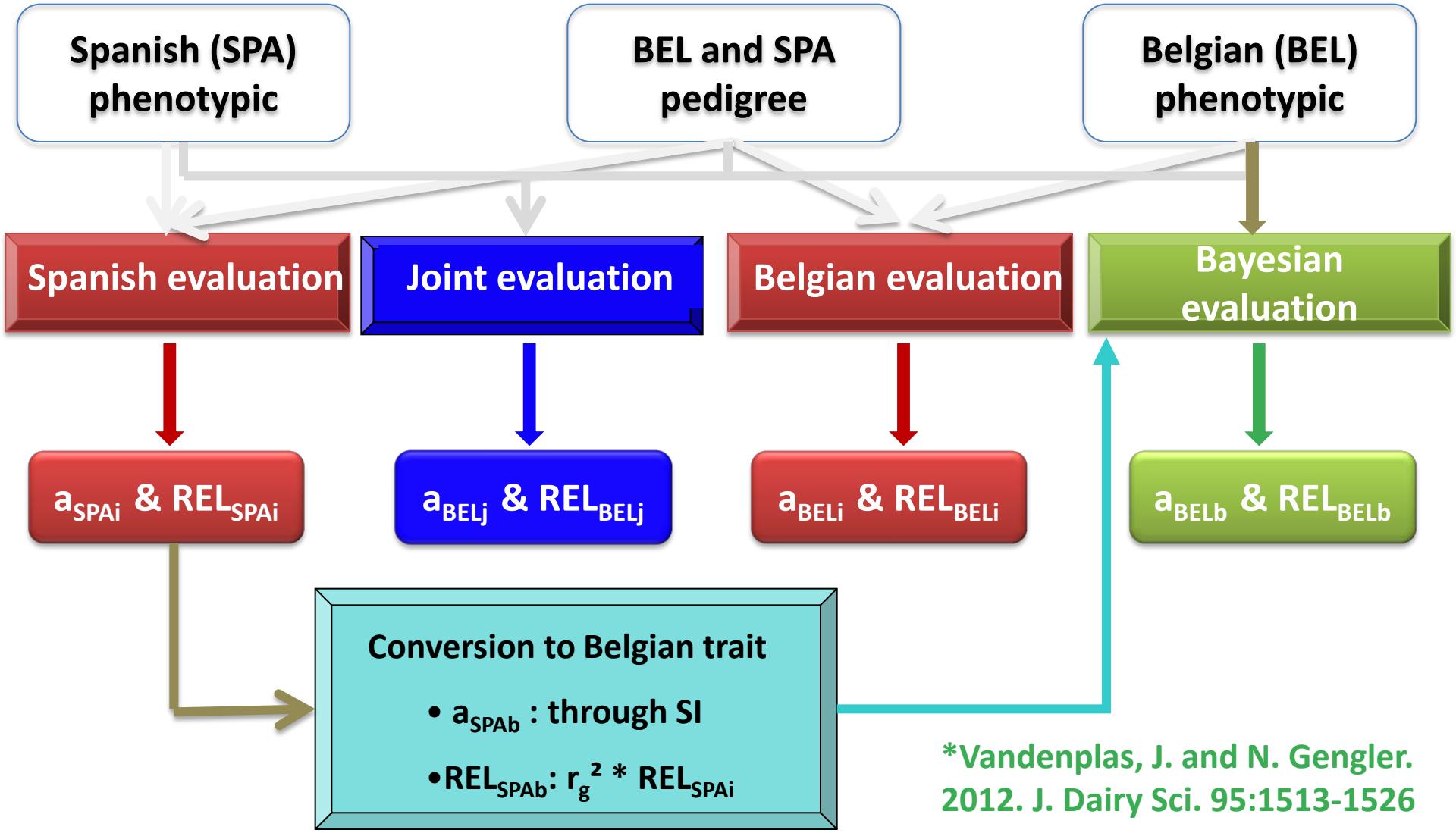
Conversion to Belgian trait
• a_{SPAb} : through SI
• REL_{SPAb}: r_g^2 * REL_{SPAi}

Methods



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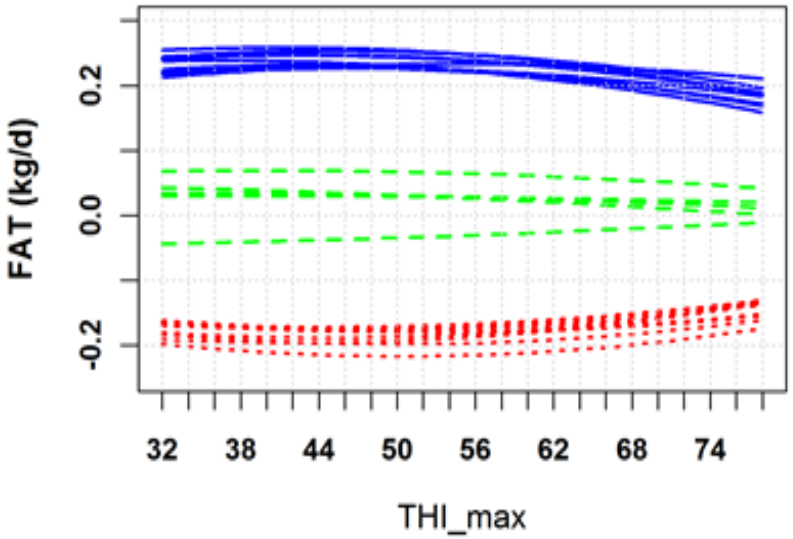
Data and pedigree

	Belgium	Spain
Nb. TD records	900,445	704,330
Nb. of cows	113,282	81,752
Milk (Kg/day)	23.3	29.4
Fat (Kg/day)	0.93	1.02
Protein (Kg/day)	0.77	0.94

Number of sires	Within-country	Common across-countries
Belgium	1,811	369 (56,265 daughters)
Spain	1,926	369 (36,212 daughters)

Heat-tolerance trait

- Lack of direct measurements of heat tolerance
- Therefore indirect heat tolerance (HT) traits:
  - Modeling reaction of performance of an individual under heat ← reaction norm
  - "Heat" expressed as Temperature-Humidity-Index (THI)
  - Regressing performances on THI
  - Regression coefficients define HT traits



Reaction norm models

- Single- (within-) and bi-variate (across-country) models

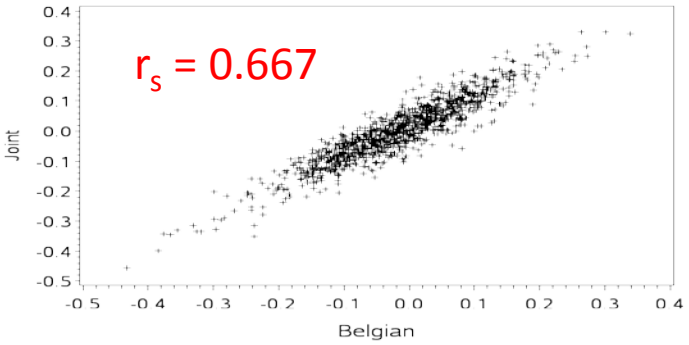
$$y = Xb + Q_{HT}Wt + Q_{HT}(Zp + Za) + e$$

- Q_{HT} matrix of 2nd order Legendre polynomials on standardized THI scale [-1,1]
- Fixed effects:
  - b = Herd x Test-day, Lactation stage, Age at calving x Season of calving
  - t = Fixed regression (mean) THI effect
- Random effects:
  - p = Random regressions for Permanent Environment THI effects
  - a = Random regressions for Additive Genetic THI effects

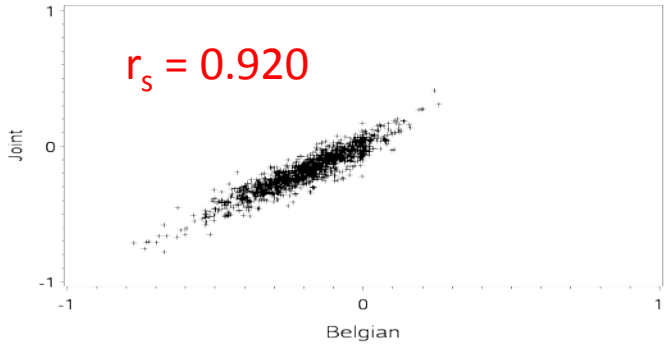
Results: Milk yield

Local Belgian | **Joint evaluation**

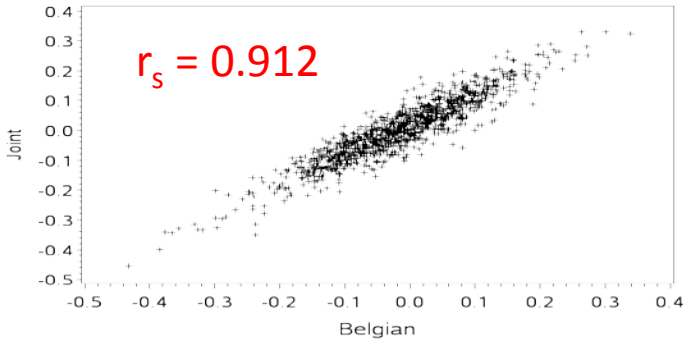
Intercept



1st order LP



2nd order LP

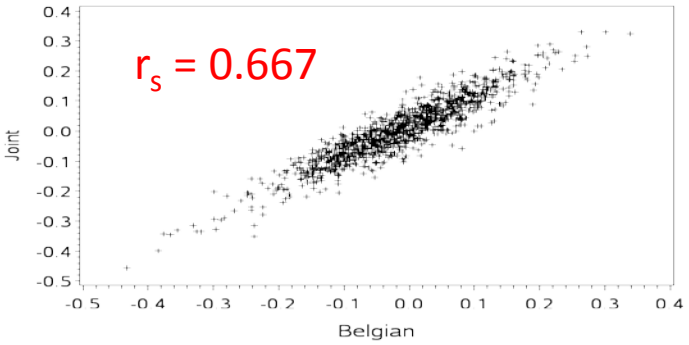


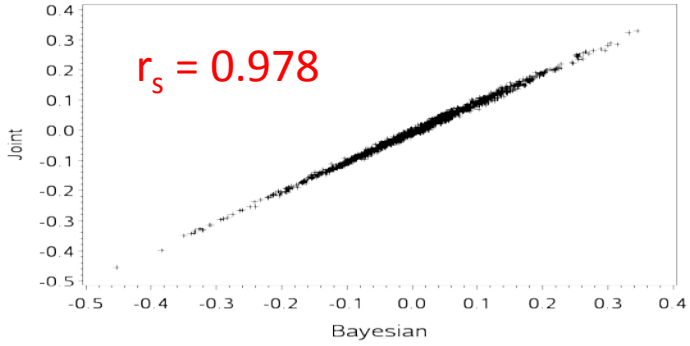
1,104 sires with Spanish daughters but without Belgian daughters

Results: Milk yield

Local Belgian | Joint evaluation | Bayesian evaluation | Joint evaluation

Intercept





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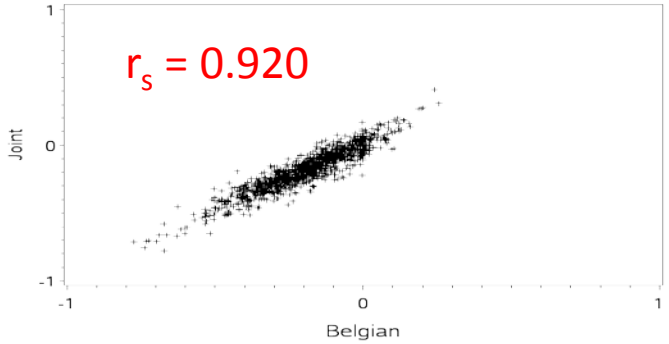

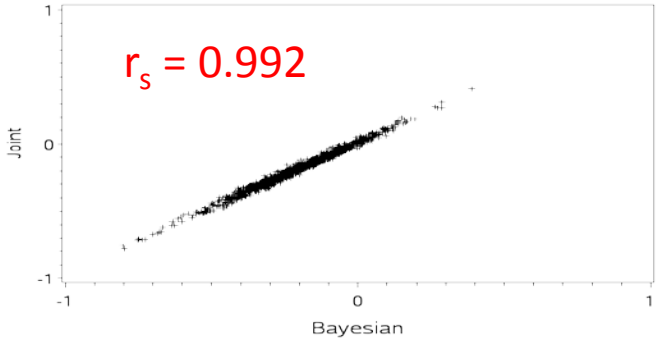

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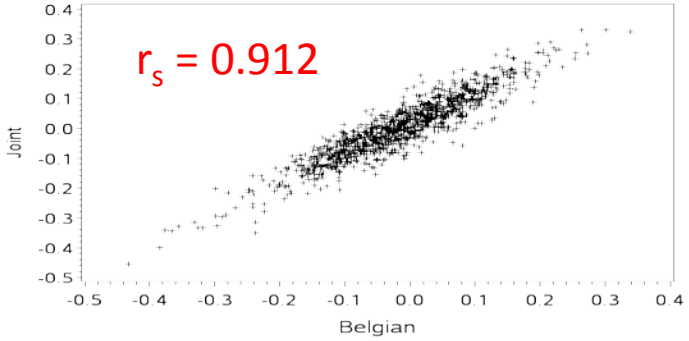
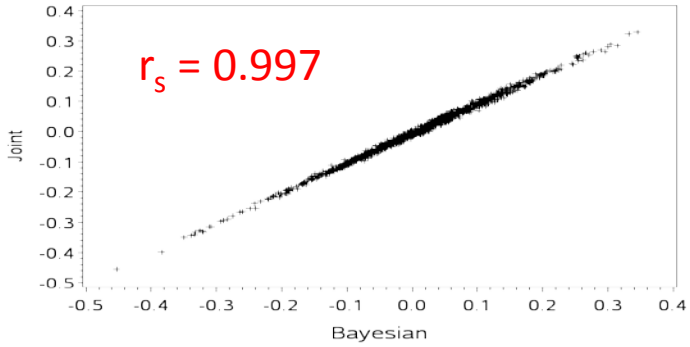


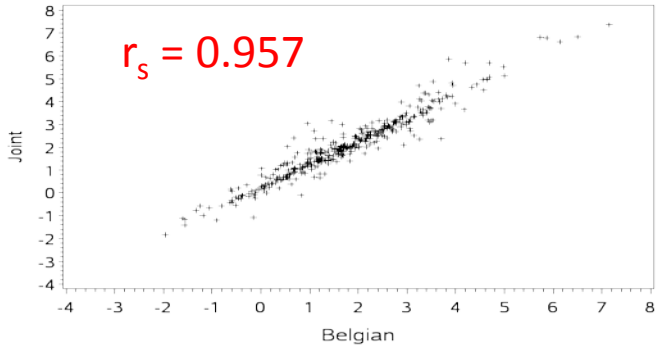


1,104 sires with Spanish daughters but without Belgian daughters

Results: Milk yield

Local Belgian | **Joint evaluation**

Intercept



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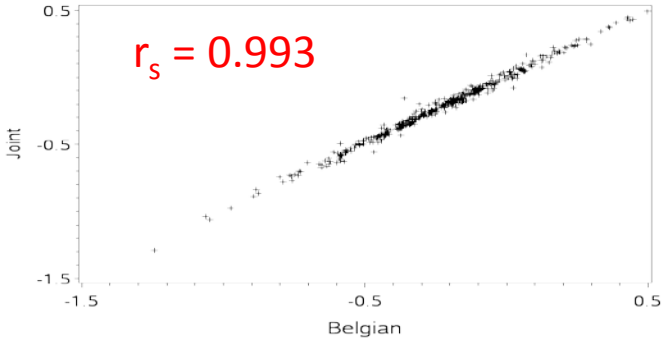

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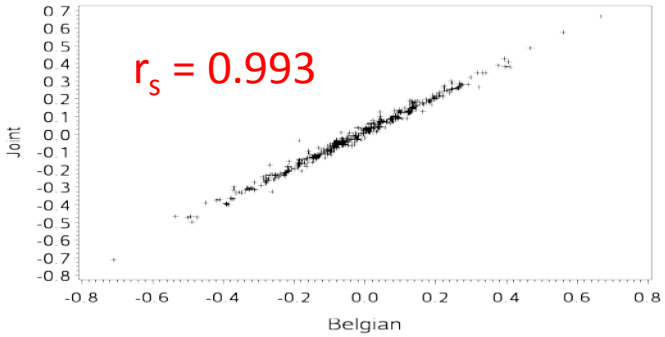
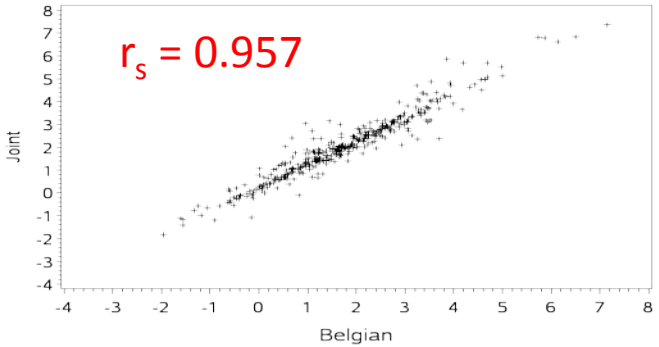


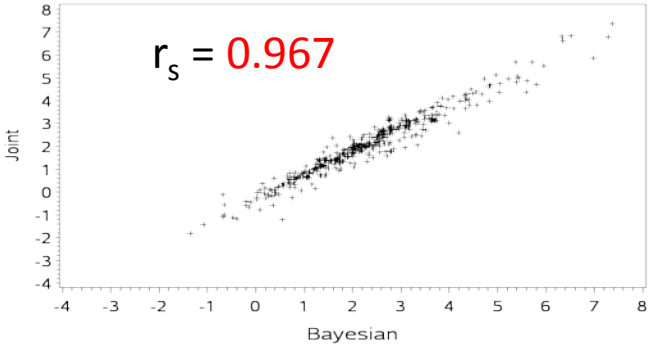
369 sires with common daughters (36,212) in Spain and (56,265) in Belgium

Results: Milk yield

Local Belgian | Joint evaluation | Bayesian evaluation | Joint evaluation

Intercept





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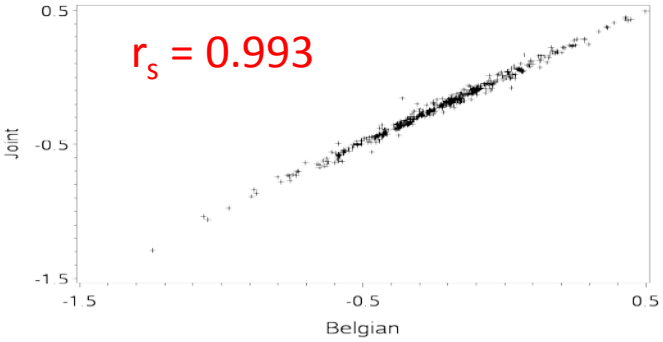

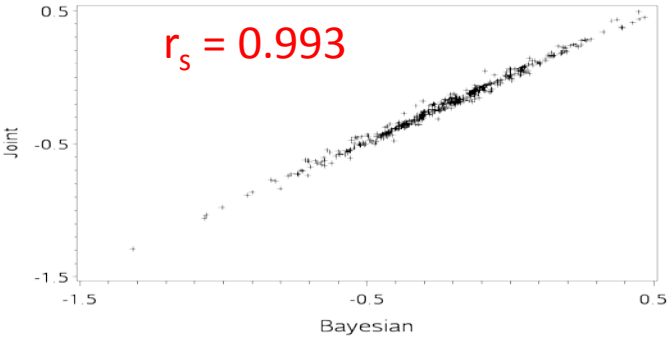

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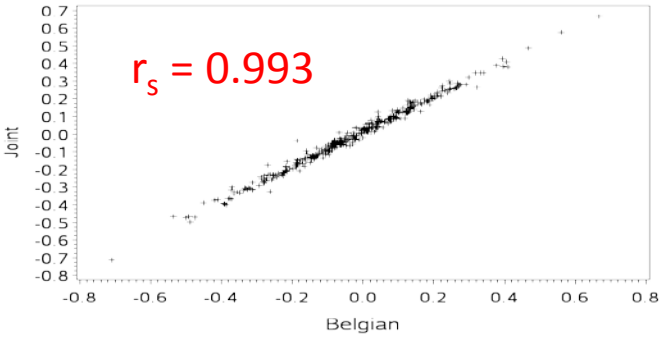

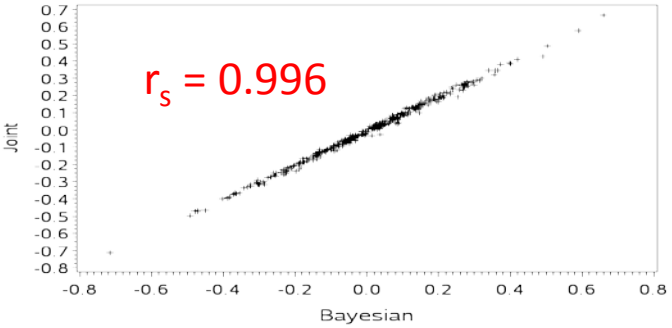

369 sires with common daughters (36,212) in Spain and (56,265) in Belgium

Results: all traits

- **Comparisons with the joint evaluation for the 1,104 sires with only Spanish daughters**

Traits	Evaluations	Rank correlations		
		Intercept	1st order	2nd order
Milk	Local Belgian	0.667	0.920	0.912
	Bayesian	0.978	0.992	0.997
Fat	Local Belgian	0.637	0.965	0.978
	Bayesian	0.980	0.994	0.989
Protein	Local Belgian	0.708	0.986	0.951
	Bayesian	0.977	0.998	0.996

Results: all traits

- **Comparisons with the joint evaluation for the 369 sires with Spanish and Belgian daughters**

Traits	Evaluations	Rank correlations		
		Intercept	1st order	2nd order
Milk	Local Belgian	0.957	0.993	0.993
	Bayesian	0.967	0.993	0.996
Fat	Local Belgian	0.958	0.996	0.992
	Bayesian	0.981	0.996	0.992
Protein	Local Belgian	0.959	0.995	0.988
	Bayesian	0.978	0.998	0.996

Conclusions

- Rankings of Bayesian evaluations more similar to rankings of the joint evaluation
- This strategy showed the interest to integrate external information from exporting countries when access to raw data not possible
- Bayesian integration can accommodate several external information sources, ongoing research includes also Luxembourg and Slovenia
- Flexibility of Bayesian integration adapted well to situation of novel trait “heat-tolerance”
- Further development of Bayesian integration towards multi-trait use will allow avoiding conversion step

Thank you for your attention

Acknowledgments

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